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DETERMINATION AND ANALYSIS OF TENSILE STRENGTH FOR EPOXY REFINED JUTE FIBER COMPOSITE REINFORCED WITH SAWDUST AND RICE HULLS

P.V.V.S.Maneendra[1], Dr. G. Ramakrishna[2], T. Veera Manikanta[3], P.Satya[4], Y.Prem kumar[5], U.Praveen[6]

Assistant Professor, Mechanical Engineering Department, GIET(A), Rajahmundry,

East Godavari District, AP, India[1]

Associate Professor, Mechanical Engineering Department, GIET(A), Rajahmundry,

East Godavari District, AP, India[2]

UG Students of Mechanical Engineering Department, GIET(A), Rajahmundry,

East Godavari District, AP, India[3,4,5,6]

ABSTRACT:

Nowadays there is an increasing demand for natural composite material because of its high-performance applications, high strength to low weight ratio, and increased environmental issues on conventional materials that lead manufacturers to adopt the technology of natural fiber composite materials and meet consumer demands. In this work, an investigation is carried out on the properties of natural fibers. we are going to prepare composite material specimens of different weight ratios with jute fibers, rice hulls, sawdust, and epoxy resin which are biodegradable. Then we perform mechanical testing to determine the Tensile Strength of the composite material and validate these results by using finite element analysis software ANSYS 2022 R1.

Keywords: *Epoxy resin, Jute fiber, rice hulls, sawdust, weight ratio.*

I. INTRODUCTION

A composite material is a material that is produced from two or more constituent materials. These constituent materials have notably dissimilar chemical or physical properties and are merged to create a material with properties, unlike the individual elements.

Composite material is made up of three types of materials using epoxy resin. The three materials are jute fiber, rice husk, and sawdust.

1.1 Fiber material

1.1.1 Sawdust

Sawdust is obtained as a waste product from the woodworking operations such as sawing, sanding, milling, and planning are released into the air, forming a layer of dust once settled. These operations can be performed by woodworking machinery. It is a biodegradable material.

1.1.2 Rice husk

Rice hulls are the hard-protecting coverings of grains of rice**.** It can be used to protect rice during the growing season, rice hulls can be put to use as a building material, fertilizer, or insulation material, it can be easily collected and is cheap, some amount of rice husk has always been used as an energy source for small applications, such as for brick production, for steam engines and gasifiers used to power rice mills, and for generating heat for rice dryers.

1.1.3 Jute fiber

It is a natural fiber with a golden and silky shine. Jute is extracted from the bark of the white jute plant. The fibers are off-white to brown, and 1–4 meters (3–13 feet) long

1.2 .MATRIX MATERIAL

EPOXY RESIN AND HARDENER

Epoxy resin systems consist of two parts, an "A" and a "B" side. The B side, also known as the "hardener", is the epoxy curing agent; the curing agent is responsible for reacting with the epoxy groups contained in the epoxy resin Aside. The reaction of curing agents with epoxy resins results in hard, thermoset materials

II. FABRICATION METHOD

The Composite material is fabricated by using natural fiber and epoxy resin. Natural fibers include jute fiber, sawdust, and rice hulls. A mold is prepared as per the specifications. A gel coat is first applied to the mold using a spray gun for a high-quality surface. When the gel coat has cured sufficiently, Jute fiber is manually placed on the mold as per the weight ratio measured by using the weighing machine. The laminating resin is applied by pouring and after that again a layer of rice hulls is placed and again resin is applied after that a layer of sawdust is placed and then presses to compress the layer and also remove entrapped air. Subsequent layers of jute fiber reinforcement are added to build laminate thickness. The resin and the hardener are mixed in a ratio of 10:1.The whole fabrication on the hand lay-up process.

The process is again repeated for the second specimen and the third specimen by varying the weight ratios of epoxy and the sawdust. The weight of different materials for different specimen are tabulated in the below table.

TABLE 2.1 WEIGHT RATIOS OF CONSTITUENTS

S.NO	MATERIALS	SPECIMEN-1 WEIGHT RATIO (%)	SPECIMEN-2 WEIGHT RATIO (%)	SPECIMEN-3 WEIGHT RATIO (%)
1	Jute fiber	8.33	8.33	8.33
2	Rice hulls	5.55	8.33	11.11
3	Sawdust	5.55	5.55	5.55
4	Resin + hardener	80.57	77.79	75.01
	Total	100	100	100

According to the ASTM D-638 standard, the specimen is prepared and subjected to mechanical testing in the local universal materials testing lab.

Fig 2.1 SPECIMENS BEFORE TESTING

Fig 2.2 SPECIMENS AFTER TESTING

III. TESTING AND VALIDATION

Mechanical Testing

By varying the weight ratios of different materials the below variations in composite material occur while tensile testing

TABLE 3.1 MECHANICAL TESTING RESULTS

S.No	SPECIMEN	Load(N)	STRESS(N/mm^2)
1.	SPECIMEN 1	233	2.533
2.	SPECIMEN 2	750	8.48
3.	SPECIMEN 3	1478	15.81

SIMULATION:

The specimen is recreated in Ansys 2022 R1 and the model is further meshed with adequate parameters. This model is subjected to respective boundary and loading conditions which yielded the results.

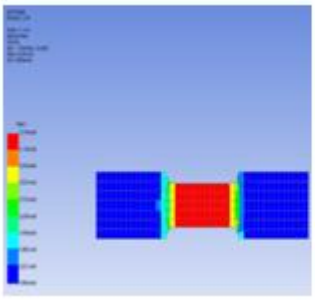


Fig 3.1 SPECIMEN 1

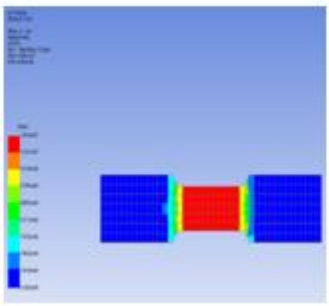


Fig 3.2SPECIMEN 2

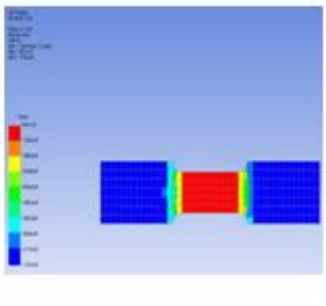


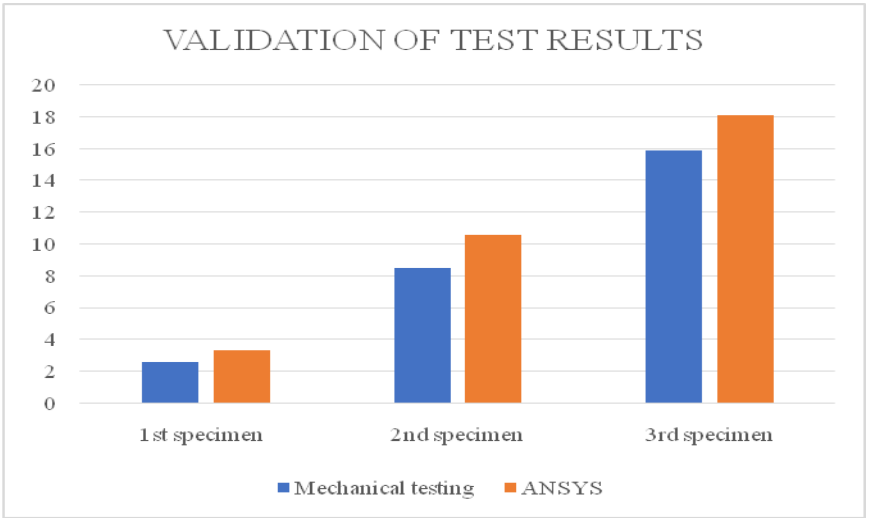
Fig 3.3 SPECIMEN 3

The obtained results are tabulated here in the below table and also the bar chart is generated to compare the results with that of mechanical testing.

TABLE 3.1 ANSYS RESULTS

S.NO	SPECIMEN	MAXIMUM STRESS(N/mm^2)
1	SPECIMEN 1	3.31
2	SPECIMEN 2	10.54
3	SPECIMEN 3	18.07

GRAPH 3.1 MECHANICAL TESTING VS SIMULATION



IV. CONCLUSION

In this paper, we determined the tensile strength of composite material using a universal testing machine, and the analysis is done in the Ansys 2022 R1 in the Ansys Composite Post module. It is an integrated tool dedicated to composite laminates modeling. Based on the validation of these mechanical testing and Ansys we can conclude that the tensile strength is more for the composite containing more percentage of rice hulls.

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